

**ABSTRACT OF THE DISCLOSURE**

The present invention is generally directed to fault detection and control methodologies for ion implant processes, and a system for performing same. In one illustrative embodiment, the method comprises performing a tuning process for an ion implant tool, the tuning process resulting in at least one tool parameter for the ion implant tool, selecting or creating a fault detection model for an ion implant process to be performed in the ion implant tool based upon the tool parameter resulting from the tuning process, and monitoring an ion implant process performed in the ion implant tool using the selected or created fault detection model. In another illustrative embodiment, the method comprises performing a tuning process for an ion implant tool, the tuning process resulting in at least one tool parameter for the ion implant tool, and determining if the tool parameter resulting from the tuning process is acceptable based on historical metrology data for implant regions formed in at least one substrate subjected to an ion implant process performed in the ion implant tool.